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WOODS HOLE OCEANOGRAPHIC INSTITUTION MASS

RESEARCH IN RELATIONS BETWEEN THE NORTH ATLANTIC SEA ICE AND AR--ETC(U)

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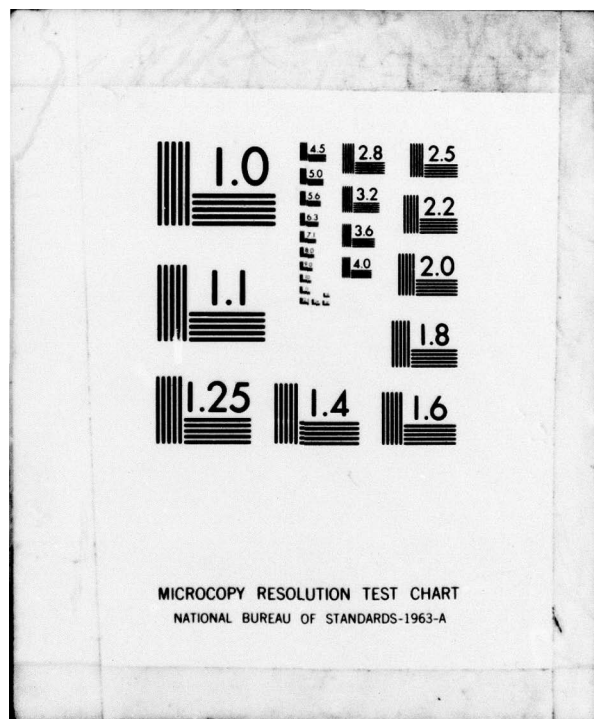
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WOODS HOLE OCEANOGRAPHIC INSTITUTION

Woods Hole, Massachusetts

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Reference No. 49-54

Research in Relations between
the North Atlantic Sea Ice and
Arctic Weather.

conducted during the period
September 15 to November 15, 1949

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Periodic Status Report, 15 Sep-15 Nov 49.
Submitted to the Office of Naval Research
Under Contract No. N6onr-277
Task Order No. 3

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C. O. N. Jordan
Director

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According to the terms of Contract N6onr-277,
Task Order No. 5, the work to be performed by the Con-
tractor shall consist of the following:

1. Select monthly and seasonal ice data beginning approximately with this century, prepared by the Danish Meteorological Institute and the International Ice Patrol, and which were treated for individual regions in a recent investigation by L. Koch (9, Koch, 1945).
2. From the available historical series of the mean monthly northern hemisphere sea-level and regional upper-air pressure charts, and also from the seasonal charts which are to be prepared, compute zonal, meridional, and other significant indices of the large-scale atmospheric circulation contemporary with and preceding various ice conditions in the several regions investigated.
3. Prepare mean monthly and seasonal series of North Atlantic sea temperatures from data collected by the International Council for the Exploration of the Sea and the Hydrographic Offices of the United States and British Navies.
4. Compute mean monthly and seasonal series of water transports in regions that have possible bearings on the ice conditions.
5. Obtain from the wind velocities to be derived from the mean monthly and seasonal sea-level pressure charts estimates of the water-transport in the trade and other North Atlantic areas for which no direct determinations can be had.
6. Develop methods for estimating the extent and mechanism of ice melting and young-ice formation.
7. Investigate possible relations between the critically evaluated dynamic and thermal circulation indices and contemporary and following ice conditions.

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A. Severity of the Iceberg Season South off Newfoundland

1. In continuance of the investigation of relations of the weather both with the iceberg severity off Newfoundland and the ice off Iceland, a check was made of the relation indicated by Groissmayr (1939) between the ice off Newfoundland and the preceding temperatures in the North Atlantic and adjacent areas* using the data for the twenty-three year period 1926 - 1949 following the series of years that figures in his computations. ← ABSTRACT

Making use of the linear correlation coefficient, the values of r for the ice with the preceding winter temperatures of St. Johns and Bermuda were, respectively, $r = 0.22$ and $r = +0.67$. Thus, while the degree of association of the ice with St. Johns and Bermuda temperatures of the preceding winter has markedly diminished during the recent twenty-three year period that of the ice with the preceding Upsala temperature has increased (see Groissmayr, 1939) so that in combination, the relation of the ice with the preceding temperatures in the North Atlantic, etc., has remained quite marked. The correlation of the computed and actual ice departures for the twenty-three year period considered yields the coefficient, $r = 0.60$.

If we further consider the years with the larger values of computed departure (either those in excess of 0.842 K or

* A discussion of the probable physical basis underlying the relations of the ice with the temperatures will be included in a technical report in preparation.

as suggested by Groissmayr or simply those in excess of the standard deviation σ), we obtain still better agreement for the nine years which fall in that category (see Table).

TABLE 1

Computed and Actual Departures of Iceberg Severity off Newfoundland on a Scale of 10

	Comp. Δ	Act. Δ		Comp. Δ	Act. Δ		Comp. Δ	Act. Δ
1926/7	0.4	0.0	1933/4	1.4*	1.0	1940/1	-0.8	-4.7
/8	-0.1	0.8	/5	0.5	2.7	/2	-3.0*	-2.4
/9	0.6	4.2	/6	-0.5	-2.8	/3	1.8*	2.4
/30	2.5*	0.6	/7	-0.2	0.6	/4	-0.4	2.0
/1	-3.1*	-2.8	/8	2.1*	1.8	/5	-0.5	3.9
/2	0.6	0.8	/9	0.7	1.8	/6	-0.3	0.1
/3	0.2	-1.1	/40	-2.8*	-4.7	/7	-1.6*	-2.0
						/8	1.3*	1.1
						/9	0.9	-2.1

* Values in excess of 0.842σ where $\kappa = \sqrt{1 - R^2}$, $R = 0.68$, $\sigma = 1.1$.

The favorable performance of Groissmayr's formula for foreshadowing the iceberg severity off Newfoundland first indicated in 1940 (Schell) and now again on the basis of ten additional years of data suggests the desirability of studying in detail the physical basis of the apparent relations and the possible application of the formula in actual foreshadowing.

2. A test of the control of the drift of the bergs in West Baffin Bay and Davis Strait which later appear in much smaller numbers off Newfoundland, by the pressure at Pt. Barrow suggested by Walker (1947) on the basis of the limited body of data available to him, showed no consistent relation, the very marked inverse association from 1921/2 to 1938/9 shown by him having been replaced by a direct association from 1949/40 to 1948/9 and also from 1899/00 to 1920/1.

Thus, the measure of the respective associations expressed in terms of the linear correlation coefficient, are: $r = 0.26$ (1899/00 - 1920/1, $n = 22$), $r = -0.74$ (1921/2 - 1938/9, $n = 18$), and $r = 0.19$ (1939/40 - 1948/9, $n = 10$). For the period as a whole, r has the value, -0.09 (1899/00 1948/9, $n = 50$).

The lack of a consistent relation between the ice off Newfoundland in late spring and early summer and the preceding October to November pressure at Pt. Barrow does not diminish the force of Walker's reasoning that the pressure distribution in the general area of Baffin Land and Labrador and adjacent waters exerts a marked influence on the concentration of bergs in that region and their southward drift to the vicinity of Newfoundland. One may conclude only that Pt. Barrow about 1,000 miles to the west, does not reflect consistently the pressure distribution over the general area of Baffin Bay, etc., and that one must consider

the pressures or whenever possible the actual winds in the areas of the iceberg concentrations themselves, as was recently attempted by Soule (1949) for the anomalous iceberg season 1947.

B. Ice off Iceland

The indication that the ice off Iceland exerts an appreciable effect on the following temperature trend in that general area reported in the summary of work done for the preceding three month period May 15 to August 15, 1949, is being considered in the light of the existing theories of the general circulation.

Also, data for the first nine years of the current decade (1941-1950) are being compiled for determining whether the mean temperature during this period followed the pattern suggested from the very light ice during the preceding decade and on the whole moderate ice during the 1940's and from the examination of the ice and temperature data for the preceding period, 1831-1940 ($n = 110$).

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- Walker, G. T., 1947, Arctic Ice Conditions and World Weather. Quart. Jour. Roy. Met. Soc., Vol. 73, pp. 226-256.